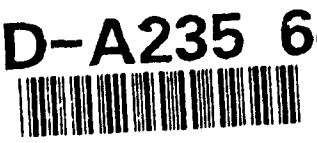

USAARL Report No. 91-2

Test and Evaluation Report of the Laerdal Suction Unit

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The Laerdal Suction Unit was tested for electromagnetic interference/compatibility in the UH-60A helicopter under the U.S. Army Test and Evaluation of Aeromedical Equipment program. The tests were conducted using current military and industrial standards and procedures for electromagnetic interference/compatibility and human factors. The Laerdal Suction Unit passed the overall evaluation and is validated as compatible with U.S. Army aeromedical aircraft.

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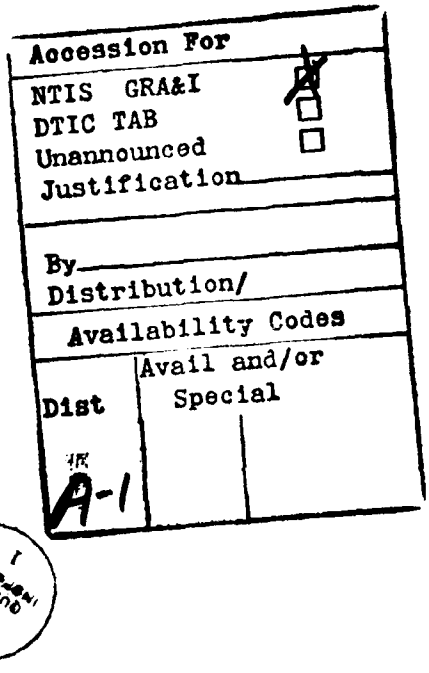


Section 1. Executive digest

The Army program for Test and Evaluation of Aeromedical Equipment uses existing military standards and collective professional expertise to test and evaluate selected medical equipment proposed for use aboard Army aircraft. Meeting these standards ensures the safety of the aircraft, crew, and patients due to: (1) interference by the medical equipment with aircraft systems/subsystems operation, (2) by the aircraft system's interference with the operation of the medical equipment, (3) the medical equipment's susceptibility to environmental exposure, or (4) physical and/or functional incompatibility while in use on board selected rotary-wing aircraft. This program tests both developmental and nondevelopmental (off the shelf) medical equipment destined for use aboard Army aeromedical aircraft.

1.1 TEST OBJECTIVES

1.1.1 To determine if the medical equipment is complete and operational per the manufacturer's operating instructions.

1.1.2 To ensure the equipment will function as designed throughout the rated battery operation time.

1.1.3 To assure the safety of the operator, the patient, and the aircrew.

1.1.4 To assess design considerations which could potentially contribute to an operator error.

1.1.5 To determine if the medical equipment can function as designed in a low pressure environment.

1.1.6 To determine the ability of the medical equipment to withstand the vibrational stresses expected in a rotary-wing flight environment without degradation or malfunction.

1.1.7 To determine the ability of the medical equipment to be stored and operated in a high temperature environment.

1.1.8 To determine the ability of the medical equipment to be stored and operated in a low temperature environment.

1.1.9 To determine the ability of the medical equipment to operate satisfactorily for short periods of time during exposure to highly humid conditions.

1.1.10 To assess the levels of electromagnetic emissions produced by the medical equipment within selected frequency ranges.

1.1.11 To assess the minimum electromagnetic susceptibility levels of the medical equipment.

1.1.12 To assess the physical and/or functional compatibility of the medical equipment while in use on board the aircraft.

1.1.13 To assess the electromagnetic interference (EMI)/electromagnetic compatibility (EMC) characteristics of the medical equipment with the host aircraft and its installed systems.

1.2 TESTING AUTHORITY

1.2.1 Research and Technology Work Unit Summary, dated 5 October 1989. Project number 3M463807D836, titled, Army program for testing and evaluation of aeromedical equipment.

1.3 SCOPE

1.3.1 This test was conducted at the United States Army Aeromedical Research Laboratory (USAARL), Cairns Army Airfield (CAAF), and designated test flight areas in and around Fort Rucker, Alabama.

1.3.2 The USAARL UH-60A aircraft, serial number 88-26069, was configured with the Laerdal Suction Unit (LSU), model LSU, and used as the test aircraft for the in-flight evaluation. The in-flight evaluation required 1.9 flight hours.

1.3.3 Laboratory testing was accomplished at the USAARL using government furnished equipment (GFE) by Universal Energy Systems, Inc., under contract No. DAMD 17-86-C-6215.

1.3.4 Prior to flight testing the following tests were accomplished: Acceptance inspection, equipment training, electromagnetic compatibility, human factors and safety, environmental compatibility, and in-flight compatibility.

1.3.5 An airworthiness release (AWR) dated 14 December 1989 was received from the U.S. Army Aviation Systems Command (AVSCOM) prior to the in-flight testing of the LSU.

1.4 MATERIAL DESCRIPTION

1.4.1 The LSU is an emergency aspirator featuring high vacuum and high free airflow. Its purpose is to remove blood, vomitus, secretions, and debris from the entire airway in order to maintain air passages in patients incapable of clearing their own secretions. The unit is entirely self contained and portable, powered on its own internal battery. With adapters, it may be powered from an external 12 volt DC source or 120 VAC, 60 Hz (not included in this test). The suction unit's main components are an electric motor, a clear plastic piston, and cylinder assembly.

Suction is created when the piston is moved in either direction, with the vacuum transferred to the collection bottle through connecting tubing. Matter can be suctioned directly through the end of the suction tubing, through a suction catheter adapter, or through an appropriate suction catheter mounted on the suction catheter adapter.

1.4.2 The LSU was operated in accordance with the manufacturer's operating instructions.

1.5 SUMMARY

1.5.1 Laboratory testing

1.5.1.1 After three cycles of discharging and recharging the battery in the LSU, it was determined the battery would last for approximately 1 hour, which is commensurate with the time specified in the operation manual for the device.

1.5.1.2 In the human factors evaluation, the LSU was found to be satisfactory in all major categories of the evaluation criteria.

1.5.1.3 Based on the results of the environmental tests conducted, the LSU meets the requirements established in the MIL-STD-810D, methods 500.2, 501.2, 502.2, 514.3, and 507.2.

1.5.1.4 Based on the results of the electromagnetic characteristics tests conducted, the LSU may be unsatisfactory for use in an EMI sensitive environment. With the LSU as a source, broadband radiated emissions in excess of military standards were detected in the range of 175 kHz to 969 MHz.

1.5.1.5 The LSU passed all radio frequency interference (RFI) susceptibility tests.

1.5.2 In-flight testing

1.5.2.1 The aircraft or its systems were not adversely affected by the operation of the LSU in any of the prescribed flight test modes.

1.5.2.2 The LSU was not affected by the aircraft or its systems during the in-flight testing.

1.5.2.3 In the in-flight human factors evaluation, the LSU was found to be satisfactory in all categories of the evaluation criteria.

1.5.2.4 Laboratory tests indicate a maximum battery life of 1 hour at full suction. The only limitation identified during both the laboratory and in-flight testing is the LSU's operation using battery power. Aeromedical missions in excess of 1 hour

would exceed the battery life of the LSU if the unit was run continuously at full power. In these instances, the battery life may be extended by reducing the power to half speed or through intermittent use. According to the manufacturer's specifications, the half speed battery life expectancy is 2 hours. Verification of half speed battery life was not included in this test.

1.6 CONCLUSIONS

Based on the combination of laboratory and in-flight testing, the LSU is validated as compatible with U.S. Army aeromedical aircraft and the subsystems listed in paragraph 3.2.2.

SECTION 2. SUBTESTS

2.1 INITIAL INSPECTION

2.1.1 Objective

To determine if the LSU is complete and operational for testing per the manufacturer's operating instructions.

2.1.2 Criteria

2.1.2.1 The physical inventory is conducted solely for investigation and documentation.

2.1.2.2 The LSU will suction 500 ml of water in approximately 5 seconds.

2.1.3 Test procedure

2.1.3.1 A complete physical inventory of the LSU was completed per the manufacturer's equipment list.

2.1.3.2 An operational validation test of the LSU was conducted per the manufacturer's operating instructions by USAARL's medical maintenance personnel.

2.1.4 Test findings

2.1.4.1 The LSU was inventoried and found to be complete. Criterion met.

2.1.4.2 The LSU operated as prescribed in the manufacturer's operating manual #79 36 00/2365. Criterion met.

2.2 BATTERY LIFE EVALUATION (Laboratory)

2.2.1 Objective

To ensure the equipment will function as designed throughout the rated battery operation time.

2.2.2 Criterion

Verify manufacturer's specified full power battery life expectancy of 1 hour.

2.2.3 Test procedure

2.2.3.1 Charging and operation cycles were conducted in ambient room conditions of 23° C, 40-60 percent humidity.

2.2.3.2 The battery was charged to full capacity according to the manufacturer's instructions. The battery then was discharged by operating the unit at full power with no load until equipment ceased to operate or until the "low battery" alarm sounded. The times were recorded to the nearest minute.

2.2.3.3 This test was repeated three times to obtain a statistically reliable operating time expectancy.

2.2.4 Test findings

After three cycles of discharging and recharging the battery in the LSU, it was determined the effective battery life is approximately 60 minutes. This is the time specified in the operation manual for the LSU. Criterion met.

2.3 HUMAN FACTORS EVALUATION (Laboratory)

2.3.1 Objectives

2.3.1.1 To assure the safety of the operator, the potential patient, and the aircrew.

2.3.1.2 To assess the design considerations which potentially could contribute to an operator error.

2.3.2 Criterion

The LSU must be rated satisfactory in all major categories of the evaluation. These include visual displays, controls, maintainability, conductors, fasteners, test points, test equipment, fuses and circuit breakers, labels and coding, and safety.

2.3.3 Test procedure

2.3.3.1 The evaluation was conducted in a laboratory under fluorescent lighting and ambient room conditions.

2.3.3.2 The LSU was operated according to prescribed instructions through its full range of functions.

2.3.4 Test findings

The LSU was found to be satisfactory in all major categories of the evaluation. Criterion met.

2.4 ALTITUDE (LOW PRESSURE) TEST [IAW METHOD 500.2, MIL-STD-810D]

2.4.1 Objective

To determine if the LSU can function as designed in a low pressure environment.

2.4.2 Criterion

The LSU will suction 500 ml of water in approximately 5 seconds while exposed to an altitude equivalency of 15,000 feet above sea level.

2.4.3 Test procedure

2.4.3.1 A pretest performance check was conducted to ensure proper operation of the LSU.

2.4.3.2 The LSU was placed in the vertical position in the altitude chamber. The pressure in the chamber was lowered to 420 mmHg (15,000 feet equivalent altitude) over 15 minutes (1000 fpm), held constant for 60 minutes, then raised to ambient atmospheric conditions (760 mmHg) at 1500 fpm. During the altitude test stage, the LSU was operating constantly with no loading.

2.4.3.3 A posttest performance check was conducted to ensure proper operation of the LSU after the exposure to low pressure.

2.4.4 Test findings

2.4.4.1 The pretest performance check met criterion 2.1.2.2.

2.4.4.2 Due to limitations of the altitude chamber, the LSU was not tested against criterion 2.4.2. In place of this test, the LSU was operated at full power for the entire low pressure cycle and its operation was monitored. There were no failures or anomalies noted. However, no quantitative data was collected.

2.4.4.3 The posttest performance check met criterion 2.1.2.2.

2.5 VIBRATION TEST [IAW METHOD 514.3, MIL-STD-810D]

2.5.1 Objective

To determine the ability of the LSU to withstand the vibrational stresses expected in a rotary-wing environment without degradation or malfunction.

2.5.2 Criterion

While exposed to vibrational stresses, the LSU will remain operational and be able to suction 500 ml of water in approximately 5 seconds.

2.5.3 Test procedure

2.5.3.1 A pretest performance check was conducted to ensure proper operation of the LSU.

2.5.3.2 The LSU was tested in the X-, Y-, and Z-axes using sinusoidal vibrations superimposed on random vibrations over a frequency range of 500 Hz, as shown below:

Z-axis

Duration: 60 minutes
Intensity: 0.7 G(rms)
Random vibration: .0006210 Gsqr/Hz
Sinusoidal vibration: .5450 Gpk at 11.25 Hz
.1690 Gpk at 22.50 Hz
.1200 Gpk at 22.50 Hz
.0310 Gpk at 45.00 Hz
.0530 Gpk at 56.25 Hz

X and Y axes

Duration: 60 minutes each
Intensity: 0.3 G(rms)
Random vibration: .0002920 Gsqr/Hz
Sinusoidal vibration: .3200 Gpk at 11.25 Hz
.0670 Gpk at 22.50 Hz
.0950 Gpk at 33.75 Hz
.0350 Gpk at 45.00 Hz
.0770 Gpk at 56.25 Hz

The test was run for 1 hour on each axis while the equipment was powered up and operating. Visual and operational checks were made during the first and last 10 minutes of each axis run.

2.5.3.3 A posttest performance check was conducted to ensure proper operation of the LSU.

2.5.4 Test findings

2.5.4.1 The pretest performance check met criterion 2.1.2.2.

2.5.4.2 The LSU functioned properly during the entire test. Criterion met.

2.5.4.3 The posttest performance check met criterion 2.1.2.2.

2.6 HIGH TEMPERATURE TEST [IAW METHOD 501.2, MIL-STD-810D]

2.6.1 Objective

To determine the ability of the LSU to be stored and operated in a high temperature environment.

2.6.2 Criteria

2.6.2.1 During the high temperature operation check, the LSU must suction 500 ml of water in approximately 5 seconds.

2.6.2.2 After the high temperature storage cycle, the LSU must be able to suction 500 ml of water in approximately 5 seconds.

2.6.3 Test procedure

2.6.3.1 A pretest performance check was conducted to ensure proper operation of the LSU.

2.6.3.2 The LSU was placed on the floor of the environmental chamber. The chamber temperature then was raised to 49° C in 15 minutes while the humidity was held constant at 15 percent for 2 hours. At 30-minute intervals, the chamber door was opened briefly and a performance check performed. At the end of the test period, the chamber was returned to ambient temperature over a 30-minute period.

2.6.3.3 The LSU was "stored" in a nonoperational mode in high temperature conditions. The LSU was placed in an environmental test chamber and the temperature was raised and held constant at 63° C for 1 hour, 71° C for 4 hours, and 63° C the sixth hour. The chamber and LSU then were returned to ambient conditions over a 30-minute period.

2.6.3.4 A poststorage performance check was conducted to ensure proper performance of the LSU.

2.6.4 Test findings

2.6.4.1 The pretest performance check met criterion 2.1.2.2.

2.6.4.2 No operational failures occurred during the high temperature test. Criterion met.

2.6.4.3 The posttest performance check met criterion 2.1.2.2.

2.6.4.4 The LSU functioned properly after the high temperature storage test. Criterion met.

2.7 LOW TEMPERATURE TEST [IAW METHOD 502.2, MIL-STD-810D]

2.7.1 Objective

To determine the ability of the LSU to be stored and operated in a low temperature environment.

2.7.2 Criteria

2.7.2.1 During the low temperature operation check, the LSU must suction 500 ml of water in approximately 5 seconds.

2.7.2.2 After the low temperature storage cycle, the LSU must be able to suction 500 ml of water in approximately 5 seconds.

2.7.3 Test procedure

2.7.3.1 A pretest performance check was conducted to ensure proper operation of the LSU.

2.7.3.2 The LSU was placed on the floor of the environmental chamber and the temperature was lowered to 0° C and held constant for 2 hours. Equipment limitations did not permit test chamber humidity levels to be set when operated at freezing temperatures. The chamber door was opened briefly every 30-minutes and a performance check was conducted. The chamber temperature then was raised to ambient temperature within a 30-minute period.

2.7.3.3 The LSU was "stored" in a nonoperational mode with the suction tube coiled in the case and the case closed in low temperature conditions. The LSU was placed on the floor of the environmental test chamber and the temperature was lowered to -46° C with 0 percent humidity for 6 hours. The temperature then was raised to ambient temperature over a 30-minute period.

2.7.3.4 A poststorage performance check was conducted to ensure proper operation of the LSU.

2.7.4 Test findings

2.7.4.1 The pretest performance check met criterion 2.1.2.2.

2.7.4.2 No operational failures occurred during the low temperature test. Criterion met.

2.7.4.3 The posttest performance check met criterion 2.1.2.2.

2.7.4.4 The LSU functioned properly after the low temperature storage test. Criterion met.

2.8 HUMIDITY TEST [IAW METHOD 507.2, MIL-STD-810D]

2.8.1 Objective

To determine the ability of the LSU to operate satisfactorily for short periods of time during exposure to highly humid conditions.

2.8.2 Criterion

While exposed to a high humidity environment, the LSU must suction 500 ml of water in approximately 5 seconds.

2.8.3 Test procedure

2.8.3.1 A pretest performance check was conducted to ensure the proper operation of the LSU.

2.8.3.2 The LSU was placed on the floor of an environmental test chamber. The chamber environment was raised to a temperature of 29.5° C and a humidity of 95 percent. These conditions were held constant for 4 hours. At 45-minute intervals, the door was opened briefly and an operational check was performed. The chamber was returned to ambient conditions over a 45-minute period.

2.8.3.3 A posttest performance check was conducted to ensure the proper operation of the LSU.

2.8.4 Test findings

2.8.4.1 The pretest performance check met criterion 2.1.2.2.

2.8.4.2 No failures were noted in the LSU performance checks conducted during the exposure to the high humidity environment. Criteria met.

2.8.4.3 The posttest performance check met criterion on 2.1.2.2.

2.9 ELECTROMAGNETIC CHARACTERISTICS TEST [IAW MIL-STD-461A notice 4, MIL-STD-462 notice 3, and MIL-STD-704C]

2.9.1 Objective

2.9.1.1 To assess the levels of electromagnetic emissions produced by the LSU within selected frequency ranges.

2.9.1.2 To assess the minimum levels of electromagnetic susceptibility levels of the LSU.

2.9.2 Criteria

2.9.2.1 The LSU shall not produce emissions in excess of the limits set forth in MIL-STD-461A notice 4, paragraph 6.13.

2.9.2.2 The LSU shall not malfunction when it is subjected to radiated fields as specified in MIL-STD-461A notice 4, paragraph 6.20.

2.9.3 Test procedure

2.9.3.1 During the radiated emissions test, the LSU was positioned on a wooden test stand inside an EMI chamber 1 meter away from the receiving antennas. The antennas were mounted for both vertical and horizonal polarities and connected to EMI receivers. While the LSU was operating, the frequency spectrum of 14 kHz to 12.4 GHz was scanned for emissions from the LSU.

2.9.3.2 During the radiated susceptibility test, the LSU was positioned on a wooden test stand inside an EMI chamber 1 meter away from the transmitting antennas. The antennas were mounted for both vertical and horizonal polarities and connected to radio frequency transmitters. The LSU was exposed to fields of 1 V/m from 10 kHz to 2 MHz, 5 V/m from 2 to 30 MHz, 10 V/m from 30 MHz to 2 GHz, and 5 V/m from 2 to 10 GHz. The LSU was monitored for faulty operation during the exposure.

2.9.4 Test findings

2.9.4.1 During the radiated emissions 14 kHz to 10 GHz test, broadband emissions were 0.5 to 7.0 dB over specification limits in the range of 175 kHz to 969 MHz. Criterion not met.

2.9.4.2 No failures occurred during the susceptibility tests. Criterion met.

2.10 IN-FLIGHT EMI/EMC CHARACTERISTICS

2.10.1 Objectives

2.10.1.1 To assess the physical and/or functional compatibility of the LSU while in use on board the aircraft.

2.10.1.2 To assess the EMI/EMC characteristics of the LSU with the host aircraft and its installed systems.

2.10.2 Criteria

2.10.2.1 The medical tester shall be able to operate the LSU without physical or functional restrictions aboard the aircraft. Major areas of concern include: Proper operation, visual displays, controls, maintainability, conductors, fasteners, test

points, test equipment, fuses and circuit breakers, labels and coding, and safety.

2.10.2.2 The LSU shall not radiate EMI to disrupt or interfere with other equipment or systems aboard the aircraft.

2.10.2.3 The aircraft shall not radiate EMI to disrupt or interfere with the LSU's operation.

2.10.3 Test procedure

2.10.3.1 A human factors evaluation was performed to ensure the compatibility of the LSU and the in-flight environment.

2.10.3.2 An EMI/EMC assessment was performed with both the LSU and the aircraft operating as source and victim. The LSU and applicable aircraft instruments and systems were monitored for unusual operation, readings, surges, or power anomalies for each checklist item.

2.10.4 Test findings

2.10.4.1 No physical or functional limitations of the LSU were noted. Criterion met.

2.10.4.2 There were no adverse instances of EMI/EMC noted with the LSU acting as either the source or victim. Criterion met.

2.10.4.3 There were no adverse instances of EMI/EMC noted with the aircraft acting as either the source or victim. Criterion met.

SECTION 3. SUPPORTING DOCUMENTATION

3.1 IN-FLIGHT TEST OPERATIONS PROCEDURES (ITOP) FOR AEROMEDICAL EQUIPMENT SUITABILITY

3.1.1 Scope

This ITOP establishes the procedures to conduct an in-flight aeromedical equipment suitability test (AEST). This test ensures that medical items undergoing aeromedical technical feasibility testing (TFT) meet compatibility requirements for specific aircraft in the Army aviation environment without major modifications or special considerations. The ITOP will validate operational procedures and performance of medical items in an actual flight environment.

3.1.2 Method

In order to evaluate aeromedical suitability, the medical item must be operated in all medical evacuation (MEDEVAC) mission profiles. In-flight tests of medical items will simulate service usage as much as possible. Data on function and performance will be compared to previous data from laboratory tests. In-flight AEST will be conducted using the UH-1 and UH-60 helicopters.

3.1.3 Preparation for test

The Director, Aeromedical Equipment Technical T&E Program, will initiate the following:

a. Aircraft and equipment. Schedule long lead time items, equipment, and aircraft far enough in advance to assure availability in the time frame required.

b. Support. Compare the proposed testing schedule against availability of all support requirement in the test directive to support the in-flight suitability test. Ensure availability of the following support as applicable:

(1) Test personnel. In-flight test team.

(2) Material documents. Test directive, operational procedure guide, nonstandard book, safety-of-flight release, manufacturer's operation manual, including test material's physical, technical, operational, and performance characteristics.

(3) Training and familiarization plan.

(4) Photographic support.

(5) Logistics support.

(6) Maintenance support.

(7) Aircraft scheduling.

3.1.4 Test controls

The in-flight AEST will be conducted and test data will be recorded in strict compliance with the test directive. If specific directions are not available, the following guidelines will prevail:

a. Measurement units will be observed and recorded in the metric and English system.

b. Numerical observations will be rounded up to the nearest hundredth.

c. Time will be recorded to the nearest minute.

d. Equipment will be properly calibrated and have a current calibration certificate.

e. All in-flight tests will be conducted and data collected in compliance with prescribed and/or standard procedures.

f. All data will be recorded on data cards and processed in a timely manner.

g. Only properly trained and qualified personnel will participate in the conduct of the test.

h. Each test run will be conducted under controlled and documented conditions, such that the test could be replicated.

i. The detailed in-flight test plan will be followed; deviations from the same will be documented.

3.1.5 Performance test

The aeromedical suitability aspect of the medical item under test shall be verified in accordance with the test directive. If specific guidance is not available, suitability will be verified in accordance with the following criteria and methodology.

3.1.5.1 Installation/removal.

a. Method. Examine and verify the following for each test item where applicable:

(1) Determine weight and balance (DD Form 365-4).

(2) Determine space/area allocation requirements on the aircraft. Verify space requirements for the medical item on board a MEDEVAC configured aircraft (both operational and storage).

(3) Interface connections are correct, positive, and secure (fasteners, connectors, snaps, belts).

(4) Installation/removal is expedient and easily achieved.

(5) Mounting of final configuration is functional and stable.

3.1.5.2 Data required.

a. Complete DD Form 365-4 (weight and balance form).

b. Complete the data collection form IAW the guideline for data collection in Appendix A.

c. Document any installation/removal incompatibility problem encountered to include the exact flight condition and procedure used when the problem occurred.

3.1.5.3 Operations and performance.

a. Method. Determine the suitability of medical items when operated on board helicopters.

(1) Determine if the medical item can be placed into operation on board the helicopter by following the operating instruction provided by the manufacturer.

(2) Complete the EMI switchology test (Appendix C). Perform all procedures associated with the medical item during all flight mission profiles to detect possible interference problems that would degrade medical equipment or aircraft function (day/night/NVG/NBC). The medical item will be operated every 5 minutes during each flight profile (on 5 minutes, off 5 minutes, and repeat).

(3) Determine any restrictions to the item's use (i.e., electrical connectors are not compatible with electrical outlets in the aircraft, etc.).

(4) Determine any deviations from the item's technical laboratory test results. Note any examples of incompatibility in the following areas:

(a) electrical/electronics - power consumed or emitted.

(b) mechanical environment - forces generated by or subjected to.

(c) human factors - user interface, effectiveness (access, marking, controls, lighting requirements), and egress.

(d) safety - hazardous characteristics which may be further amplified when interfaced with other items.

b. Data required

(1) Complete the data collection form IAW the guideline for data collection found in Appendix A.

(2) Document problems involved with using the manufacturer's operational checklist in the flight environment.

(3) Document each case of incompatibility on the data card, listing exact characteristics causing the problem. Record the following:

(a) type of aircraft.

(b) conditions and procedure being performed when the problem occurred.

(c) other on-board systems involved. Document the problem (what, when, how long) including the exact condition and procedure when the problem occurred.

(4) Document each condition where in-flight operational characteristics of the test item deviates from the laboratory test results.

3.1.6 In-flight procedures checklist

Appendix B

OPERATING PROCEDURES CHECKLIST

IN-FLIGHT SUITABILITY TEST OF MEDICAL ITEMS

BEFORE STARTING AIRCRAFT ENGINES

1. Forms/records - Check for the test plan, availability of the manufacturer's test item operations manual; check the nonstandard book for the test item inventory, summary of pilot actions, in-flight test profile planning data, AVSCOM airworthiness release, mission limitations, DD Form 365-4 (Clearance Form F), pilot postflight actions, and data cards.

2. Calibration - Check for current calibration.

3. Install the test item - Note all observations and complete the data card.

4. External power source - Connect to the aircraft.

5. Test item - Turn on and complete a functional check. For medical items that operate on either battery packs or aircraft AC power, functional checks will be conducted in both power modes. Confirm that the test item meets the manufacturer's design operational specifications. Functional checks will simulate the use for which the item is designed. Note all observations and complete the date card.

6. Test item - Turn off.

7. External power source - Disconnect from the aircraft.

AIRCRAFT ENGINE RUNUP

With the engine runup completed and the aircraft engines at operating RPM, complete the following checks:

1. Test item - Turn on.

2. System interface - Check. Place the test item in operation and complete the following checks. Note any degradation in medical item or aircraft functions. Complete the EMI switchology checklist (Appendix C). Note all observations and complete the date card.

a. Voltage - Check.

b. Flight controls (UH-60) - Check full range IAW the operator's manual checklist.

c. Stabilator (UH-60) - Check full range IAW the operator's manual checklist.

d. Radios - Make operational checks on the FM, UHF, and VHF radios IAW the operator's manual checklist.

e. Navigation equipment - Make operational checks on the transponder, DOPPLER, ADF, and VOR radios IAW the operator's manual checklist.

f. Radar altimeter - Check IAW the operator's manual checklist.

HOVER CHECK - Check system interface. While at a stabilized hover (IGE), place the test item into operation and complete the following checks. Note any degradation in medical item or aircraft functions. Complete the EMI switchology checklist (Appendix C). Note all observations and complete the data card.

1. Voltage - Check.

2. Radios - Make operational checks on the FM, UHF, and VHF radios.

3. Navigation equipment - Make operational checks on the transponder, DOPPLER, ADF, and VOR radios IAW the operator's manual checklist.

PERFORM THE FLIGHT MISSION PROFILE - Operate the test item during each mission profile. Turn the medical item on with an operational check every 5 minutes, then turn the medical item off for 5 minutes and repeat. Note any degradation in medical item or aircraft functions. Complete the EMI switchology checklist Appendix C). Note all observations and complete the data card. The flight mission profile will consist of the following tasks:

1. Perform straight and level flight at 1000 ft MSL for 20 minutes at the following airspeeds. Conduct communication checks on the FM, UHF, and VHF radios.

a. UH-1 - 110 KIAS

b. UH-60 -150 KIAS

2. Perform NOE flight for 20 minutes at varying airspeeds.

3. Perform FM homing for 10 minutes (can be included in the straight and level flight at 1000 ft MSL).

4. Perform DOPPLER navigation for 20 minutes (initialize, fix, and update).

5. Perform VOR navigation at 7000 ft MSL for 20 minutes at the following airspeeds:

(1) UH-1 - 100 KIAS

(2) UH-60 - 140 KIAS

6. Perform an ILS approach.

AFTER LANDING CHECK

1. Test item - Turn off prior to aircraft engine shutdown.

2. External power source - Connect to the aircraft.

3. Test item - Turn on and complete a functional check. Confirm that the test item still meets the manufacturer's design operational specifications. Note all observations and complete the data card.

4. Test item - Turn off.

5. External power source - Disconnect from the aircraft.

6. Remove the test item - Note observations and complete the data card.

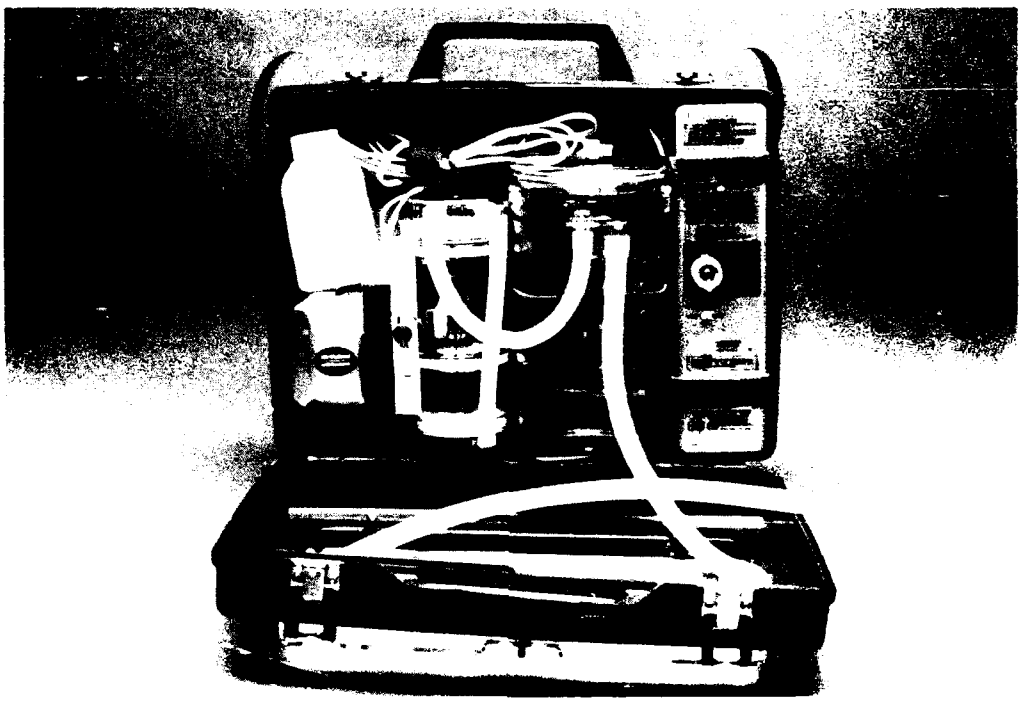
7. Calibration - Check.

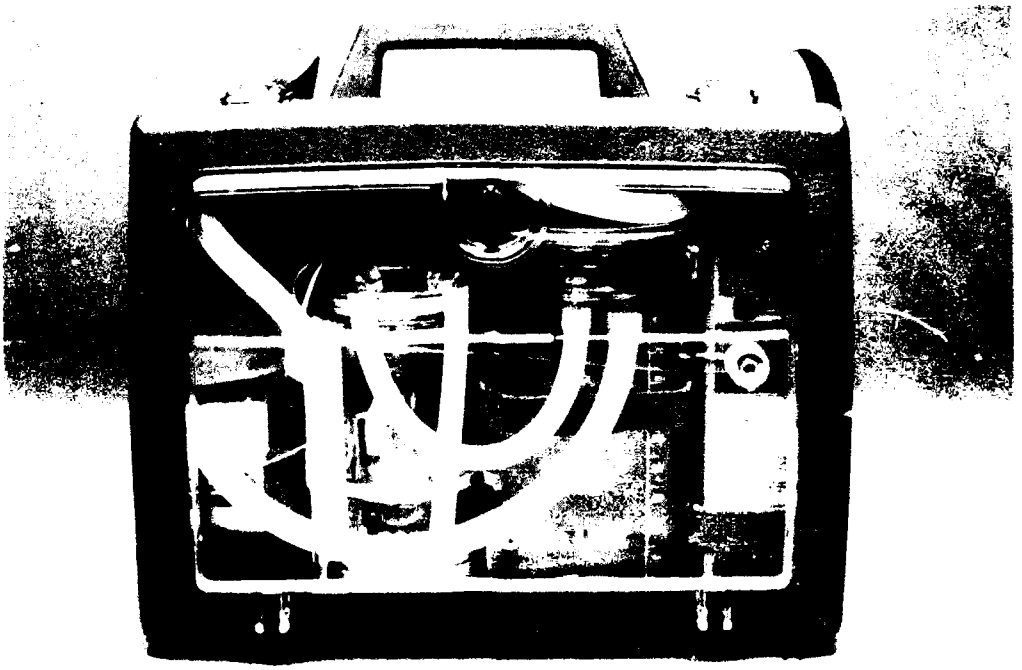
NONSTANDARD BOOK - Complete all required forms and summary of pilot actions.

POST MISSION DEBRIEF - As a minimum, the in-flight test team will review the data card for completeness and accuracy.

3.2 TEST DATA

3.2.1 Photographic description





3.2.2 Aircraft equipment list

Item No.	Nomenclature
1	Receiver radio - R-1496A/ARN-89
2	Displacement gyro - CN-1314/A
3	Gyro directional - CN-998/ASN-43
4	Signal data convercer - CV-3338/ASN-128
5	Receiver - R-2139/ARN-123
6	Command instrument system processor - 70600-01038-101
7	SAS amplifier - 70901-02908-104
8	Rate gyro - TRU-2A/A
9	Amplifier, impedance - AM-4859A/ARN-89
10	Cargo hook - FE-7590-145
11	Receiver, radar - RT-1193/ASN-128
13	Barometric altimeter - AAU-31/A-1
14	Barometric altimeter - AAU-32A
15	Receiver/transmitter - RT-1300/ARC-186
16	UHF-FM radio set - RT-1518/ARC-164
17	Interphone control - C6533/ARC
18	Receiver/transmitter - RT-1115D/APN-209
19	Indicator altimeter - ID-1917C/APN-209
20	Control radio set - C-7392A/ARN-89
21	Comparator signal data - CM-482/ARC-186
22	Receiver/transmitter - RT-1296A/APX-100
23	Computer display unit - CP-1252/ASN-128
24	Compass set controller - C-8021E/ASN75
25	Magnetic compass - standby - MS-17983-4

3.2.3 In-flight test data

Appendix A

DATA CARD FORMAT

GUIDELINE FOR DATA COLLECTION

IN-FLIGHT SUITABILITY TEST OF MEDICAL ITEMS

1. Installation/removal.	Suitable Yes	Suitable No	Comments
a. Weight and balance (DD Form 365-4, Clearance Form F).	X		
b. Space/area allocation.			
(1) Operational requirements.	X		
(2) Storage requirements.	X		
c. Interface connections (safe, positive, secure).	X		
d. Installation/removal (expedient/easily achieved).	X		
e. Mounting/final configuration (functional/stable).	X		

2. Operations and performance.	Suitable Yes	Suitable No	Comments
a. Manufacturer's operating instruction.	X		
b. Medical item operation before aircraft runup.	X		
c. System interface during aircraft engine runup and medical item operation (EMI switchology checklist).	X		
(1) Aircraft voltage output.	X		

	Suitable Yes	No	Comments
(2) Flight control function (UH-60).			
(3) Stabilator function (UH-60).	X		
(4) Radio communication vs medical item operation.			
(a) FM	X		
(b) UHF	X		
(c) VHF	X		
(5) Navigation equipment vs medical item operation.			
(a) Transponder	X		
(b) ADF	X		
(c) VOR	X		
(d) DOPPLER	X		
(6) Radar altimeter operation vs medical item operation.	X		
d. System interface during aircraft hover and medical item operation (EMI switchology checklist).			
(1) Voltage output.	N/A		
(2) Radio communication vs medical item operation.			
(a) FM	X		
(b) UHF	X		
(c) VHF	X		

(3) Navigation equipment operation vs medical item operation.	Suitable Yes	No	Comments
(a) Transponder	X		
(b) ADF	X		
(c) VOR	X		
(d) DOPPLER	X		
e. Flight mission profile vs medical item operation (EMI switchology checklist).			
(1) Straight and level (1000 ft MSL for 20 minutes).			
(a) Compatibility of flight mode and medical item operation.	X		
(b) Radio communication vs medical item operation.			
(1) FM	X		
(2) UHF	X		
(3) VHF	X		
(2) NOE (20 minutes). compatibility of flight mode and medical item operation.	X		
(3) FM homing (10 minutes).	X		
(4) DOPPLER navigation vs medical item operation.			
(a) Initialize function.	X		
(b) Fix function.	X		
(c) Update function.	X		

	Suitable Yes	No	Comments
(5) VOR navigation (7000 ft MSL for 20 minutes) vs medical item operation.	X		
(6) ILS approach vs medical item operation.	X		
f. Medical item operation after engine shutdown (external power source).	X		
g. Restrictions to the medical item's use (i.e., electrical connectors).	X		
h. Deviations from the laboratory test results.			
(1) Electrical/electronic.			None
(2) Mechanical environment.			None
(3) Human factors (user interface, controls, markings, lighting, egress).			None
(4) Safety.			None

3. Deviations from the in-flight test protocol.

a. The VOR navigation portion of the in-flight test conducted at 2000 feet MSL due to air traffic control clearance.

b. The nap-of-the-earth (NOE) flight mode conducted at Highfalls Stagefield.

3.2.4 EMI Switchology Checklist

Appendix C

EMI SWITCHOLOGY CHECKLIST UH-60 AIRCRAFT

IN-FLIGHT SUITABILITY OF MEDICAL ITEMS

ENG INSTRUMENTS/CDU Explanation	No EMI Affect	EMI Affected Gnd	EMI Affected Flt
Fuel quantity	X		
Fuel indicator test	X		
XMSN oil temperature	X		
XMSN oil pressure	X		
#1 engine oil temperature	X		
#2 engine oil temperature	X		
#1 engine oil pressure	X		
#2 engine oil pressure	X		
#1 TGT	X		
#2 TGT	X		
#1 Ng speed	X		
#2 Ng speed	X		
CDU digits on/off	X		
CDU instruments dim	X		

ENG INSTRUMENTS/PLT PDU Explanation	No EMI Affect	EMI Affected Gnd	EMI Affected Flt
#1 engine RPM	X		
#2 engine RPM	X		
Rotor RPM	X		
#1 torque	X		
#2 torque	X		

ENG INSTRUMENTS/COPLT PDU Explanation	No EMI Affect	EMI Affected Gnd	EMI Affected Flt
#1 engine RPM	X		
#2 engine RPM	X		
Rotor RPM	X		
#1 torque	X		
#2 torque	X		

ENG CONTROLS	No EMI Affect	EMI Affected Gnd	Flt	Explanation
#1 overspeed	X			
#2 overspeed	X			
RPM switch	X			
#1 engine anti-ice	X			
#2 engine anti-ice	X			
#1 inlet anti-ice	X			
#2 inlet anti-ice	X			

RADIO EQUIPMENT	No EMI Affect	EMI Affected Gnd	Flt	Explanation
ICS, C-6533 ARC	X			
VHF-FM, ARC-114A (#1)	X			
VHF-FM, ARC-114A (#2)	Not installed			
VHF-FM, ARC-186/115	Not installed			
VHF-AM, ARC-164	X			
Crypto, KY-28	Not installed			
Radio retransmissions PLN	Not installed			
Transponder, APX-100(V)	X			
KIT-1A/TSEC IFF computer	X			

MISSION EQUIPMENT	No EMI Affect	EMI Affected Gnd	Flt	Explanation
RWR, APR-39(V)	Not installed			
IR CM, ALQ-144	Not installed			
Chaff dispenser, M-130	Not installed			
Cargo hook system	X			

HYDRAULIC CONTROL SYSTEM	No EMI Affect	EMI Affected Gnd	Flt	Explanation
Backup hydraulic pump	X			
Servo off 1st stage/PLT	X			
Servo off 2nd stage/PLT	X			
Servo off 1st stage/COPLT	X			
Servo off 2nd stage/COPLT	X			
Hydraulic leak test	X			
Tail servo	X			
Boost servos	X			

FUEL SYSTEM	No EMI Affect	EMI Affected Gnd	Flt	Explanation
Fuel pump switch	X			
Fuel boost pump #1	X			
Fuel boost pump #2	X			
Fuel cont panel ESSS	Not installed			

WARNING SYSTEM	No EMI Affect	EMI Affected Gnd	Flt	Explanation
Low rotor RPM	X			
Master caution	X			
Caution advisory	X			
Fire warning	X			
AFCS	X			
Stabilator	X			
NVG engine	Not tested			
#1 engine out	X			
#2 engine out	X			

NAVIGATION INSTRUMENTS	No EMI Affect	EMI Affected Gnd	Flt	Explanation
ADF	X			
Magnetic compass	X			
CONUS NAV, ARN-123	X			
DOPPLER, ASN-128	X			
Gyro mag compass (PLT)	X			
Gyro mag compass (COPLT)	X			
Compass cont panel, ASN-75	X			
HSI	X			

FLIGHT INSTRUMENTS	No EMI Affect	EMI Affected Gnd	Flt	Explanation
Radar altimeter	X			
Stabilator pos indicator	X			
VSI	X			
CIS mode select	X			
SAS 1	X			
SAS 2	X			
FPS	X			
Trim	X			
Go-around enable	X			
Cyclic trim release	X			
Cyclic stick trim	X			
TLR encoder	X			

FLIGHT INSTRUMENTS (CONT)	No EMI Affect	EMI Affected Gnd	EMI Affected Flt	Explanation
HSI/VSI mode select (PLT)				
DPLR	X			
VOR/ILS	X			
BACK CRS	X			
FM HOME	X			
TURN RATE	X			
CRS HDG	X			
VERT GYRO	X			
BRG 2	X			
HSI/VSI Mode Select (COPLT)				
DPLR	X			
VOR/ILS	X			
BACK CRS	X			
FM HOME	X			
TURN RATE	X			
CRS HDG	X			
VERT GYRO	X			
BRG 2	X			

MISCELLANEOUS EQUIPMENT	No EMI Affect	EMI Affected Gnd	EMI Affected Flt	Explanation
Blade de-ice	Not tested			
Windshield anti-ice	X			
Pilot heat	X			
Vent blower	X			
Windshield wiper	X			
Heater	X			
APU	X			
Generator #1	X			
Generator #2	X			
Generator APU	X			
Air source heat start	X			
Tail wheel lock	X			
Gyro erect	X			

LIGHTING	No EMI Affect	EMI Affected Gnd	EMI Affected Flt	Explanation
Cockpit utility	X			
Cockpit flood	X			
Cabin dome	X			
Search light	X			
Search light control	X			
Landing light	X			
Flt instr lights (PLT)	X			
Flt instr lights (COPLT)	X			
Nonflight instr lights	X			
Console lights, upper	X			
Console lights, lower	X			
Position lights	X			
Formation lights	X			
Anticollision lights	X			
NVG lighting	X			

Test and evaluation number: 2

Human Factors Evaluation
Report Form

Nomenclature: Suction pump
Manufacturer: Laerdal
Model number: LSU
Serial number: 034892
Military item number: A0137

Options installed: None

Date of test: 30 June 1988

Item configuration during test:

The suction pump, ready to operate, was sitting vertically on a desk.

Checklist for HFE

RESULTS

VISUAL DISPLAYS: Satisfactory

display type, format, content
location of displays
indicator lights
scalar displays
color coding
legends and labels
cathode ray tubes
counters
flags, go/no go, center-null indicators

Comments: None

CONTROLS: Satisfactory

location
characteristics of controls
labeling
control - display relationships

Comments: None

MAINTAINABILITY: Satisfactory

component location
component characteristics
rests & stands
covers, cases, access doors
handles
lubrication
component mounting
cord storage provisions
external accessibility
internal accessibility
list special tools required
list realistic inspection requirements
list realistic inspection intervals

Comments: None

CONDUCTORS: Satisfactory

binding & securing
length
protection
routing
conductor coding
fabrication
connectors

Comments: None

FASTENERS: Satisfactory

access through inspection panel covers
enclosure fasteners
device mounting bolts & fasteners

Comments: None

TEST POINTS: N/A

general
location & mounting
test point labeling & coding

Comments: None

TEST EQUIPMENT: N/A

general
equipment self-test
indicators (list in comments)
controls
positive indication of proper operation

Comments: A test adaptor is listed in the equipment manual, but the adaptor was not provided with the suction pump.

FUSES & CIRCUIT BREAKERS: Satisfactory

external accessibility
easy replacement or reset by operator

Comments: None

LABELS & CODING: Satisfactory

placed above controls and displays
near or on the items they identify
not obscured by other equipment components
describe the function of the items they identify
readable from normal operating distance
conspicuous placards adjacent to hazardous items

Comments: None

SAFETY: Satisfactory

manual
materials
fire & explosive protection
operator protection from mechanical hazards
patient protection from mechanical hazards
electrical safety (operator and patient)

Comments: None

Test & Evaluation Number: 2

Altitude Test
Report Form

Nomenclature: Suction pump
Manufacturer: Laerdal
Model Number: LSU
Serial Number: 034892
Military item number: A0137
Options installed: None

Test equipment used:

Guardite 20-man altitude chamber, serial number 61824010.

Date of test: 5 July 1988

Item configuration during test:

The suction pump was in the vertical position in the altitude chamber and the suction pump was operating.

Performance test criterion:

The suction pump was to suction 500 ml of water in approximately 5 seconds.

Ambient conditions outside chamber:

Temperature	91 degrees F
Humidity	65 percent
Barometric pressure	1 atm

PRETEST DATA

Pretest performance check:

Item functional (based on performance test criterion):	Yes, 500 ml: 4.8 seconds

Installation of item in test facility:

list connections to power	None (internal battery)
list connections to simulators	None
list connections to dummy loads	None
list unconnected terminals	External power/charger connector

IN-TEST DATA

Time of test start: 14:03

POSTTEST DATA

Posttest performance check:
(complete check of item and accessories)

Time of test end:	15:28
Item functional (based on performance test criterion):	Yes, 500 ml: 4.6 seconds
Deviation from pretest:	None

Comments on item setup or checks:

Since the battery had been taxed due to vibration tests performed earlier, the post-test performance check was performed after the battery had been recharged.

Comments on test run (including interruptions):

Comments on other data: None

Test & Evaluation Number: 2

Vibration Test Report Form

Nomenclature: Suction pump
Manufacturer: Laerdal
Model number: LSU
Serial number: 034892
Military item number: A0137
Options installed: None

Test equipment used:

Unholtz-Dickey model TA115-40/CSTA Vibration Test System

Date of test: 5 July 1988

Item configuration during test:

The suction pump was mounted to the vibration table.

Performance test criterion:

The suction pump was to suction 500 ml of water in approximately 5 seconds.

PRETEST DATA

Pretest Performance Check:

Item functional: (based on performance test criterion)	Yes, 500 ml: 4.5 seconds

Installation of item in test facility:

list connections to power	None (internal battery)
list connections to simulators	None
list connections to dummy loads	None
list unconnected terminals	External power/charger connector

Ambient conditions

Temperature:	80 degrees F
Humidity:	80 percent
Barometric pressure:	1 atm

IN-TEST DATA

Data and performance checks during test:

Times and dates of test start:

X: 8:23 Y: 9:30 Z: 13:00

Time at first check:

X: 8:35 Y: 9:35 Z: 13:06

Item functional: Yes, 500 ml: x-axis 4.5 seconds,
(based on performance y-axis 4.7 seconds,
test criterion) z-axis 4.8 seconds

Deviation from pretest: None

Time at second check:

X: 9:15 Y: 10:27 Z: 13:51

Item functional: Yes, 500 ml: x-axis 4.3 seconds,
(based on performance y-axis 4.8 seconds,
test criterion) z-axis 4.8 seconds

Deviation from pretest: None

POSTTEST DATA

Time at test end:

X: 14:01 Y: 10:30 Z: 14:00

Posttest performance check:
(complete check of item and accessories)
Item functional Yes 500 ml: 4.8 seconds
(based on performance
test criterion)

Item intact: Yes
Deviation from pretest: None

Comments on item setup or checks: None

Comments on test run (including interruptions): None

Comments on other data: None

Test & Evaluation Number: 2

High Temperature Test
(Equipment operating)
Report Form

Nomenclature: Suction pump
Manufacturer: Laerdal
Model number: LSU
Serial number: 034892
Military item number: A0137
Options installed: None

Test equipment used:

Tenney Engineering model ZWUL-10107D walk-in controlled environment chamber.

Date of test: 30 June 1988

Item configuration during test:

The pump was sitting vertically in the chamber and was ready for operation.

Performance test criterion:

The pump was to suction 500 ml of water in approximately 5 seconds

Ambient conditions outside chamber:

Temperature	27 degrees C
Humidity	50 percent
Barometric pressure	1 atm

PRETEST DATA

Pretest performance check:

Item functional (based on performance test criterion):	Yes

Installation of item in test facility:

list connections to power	None (internal battery)
list connections to simulators	None
list connections to dummy loads	Water reservoir during checks
list unconnected terminals	External power/charger connector

distance from north wall (meters) 0.75
distance from south wall (meters) 0.75
distance form east wall (meters) 2.00
distance from west wall (meters) 2.00
distance from ceiling (meters) 2.16
distance from floor (meters) 0.00

Time of test start: 9:05

Performance checks during test:

First check:

Time: 9:35
Temperature: 49 degrees C
Humidity: 15 percent
Barometric pressure: 1 atm
Item functional (based on performance test criterion):
Yes 500 ml: 4.6 seconds
Deviation from pretest: None

Second check:

Time: 10:35
Temperature: 49 degrees C
Humidity: 15 percent
Barometric pressure: 1 atm
Item functional (based on performance test criterion):
Yes 500 ml: 4.5 seconds
Deviation from pretest: None

Third check:

Time: 11:05
Temperature: 49 degrees C
Humidity: 15 percent
Barometric pressure: 1 atm
Item functional (based on performance test criterion):
Yes 500 ml: 4.6 seconds
Deviation from pretest: None

POSTTEST DATA

Posttest performance check:
(complete check of item and accessories)
Time of test end: 11:35
Item functional: (based on performance test criterion):
Yes 500 ml: 4.6 seconds
Deviation from pretest: None

Comments on item setup or checks: None

Comments on test run (including interruptions): None

Comments on other data: None

Test & Evaluation Number: 2

High Temperature Test
(equipment in storage)
Report Form

Nomenclature: Suction pump
Manufacturer: Laerdal
Model number: LSU
Serial number: 034892
Military item number: A0137
Options installed: None

Test equipment used:

Tenney Engineering model ZWUL-10107D Walk-in Controlled Environment Chamber.

Date of test: 1 July 1988

Item configuration during test:

The cover of the pump was closed and the unit was sitting horizontally in the chamber.

Performance test criterion:

The pump was to suction 500 ml of water in approximately 5 seconds.

Ambient conditions outside chamber:

Temperature	26 degrees C
Humidity	55 percent
Barometric pressure	1 atm

PRETEST DATA

Pretest performance check:
Item functional (based on performance test criterion): Yes

Installation of item in test facility:

list connections to power	None
list connections to simulators	None
list connections to dummy loads	None
list unconnected terminals	External power/charger connector
distance from north wall (meters)	0.75
distance from south wall (meters)	0.75

distance form east wall (meters) 2.0
distance from west wall (meters) 2.0
distance from ceiling (meters) 2.16
distance from floor (meters) 0.0

Time of test start: 8:15
Midtest time: N/A
Midtest temperature: N/A
Midtest humidity: N/A

POSTTEST DATA

Posttest performance check:
(complete check of item and accessories)
Time of test end: 15:15
Item functional (based on performance test criterion):
Yes 500 ml: 4.3 seconds
Deviation from pretest: None

Comments on item setup or checks: None

Comments on test run (including interruptions): None

Comments on other data: None

Test & Evaluation Number: 2

Low Temperature Test
(equipment operating)
Report Form

Nomenclature: Suction pump
Manufacturer: Laerdal
Model number: LSU
Serial number: 034892
Military item number: A0137
Options installed: None

Test equipment used:

Tenney Engineering model ZWUL-10107D Walk-in Controlled Environment Chamber.

Date of test: 30 June 1988

Item configuration during test:

The pump was ready to operate and sitting vertically on the chamber floor.

Performance test criterion:

The pump was to suction 500 ml in approximately 5 seconds.

Ambient conditions outside chamber:

Temperature	27 degrees C
Humidity	50 percent
Barometric pressure	1 atm

PRETEST DATA

Pretest performance check:

Item functional (based on performance test criterion): Yes

Installation of item in test facility:

list connections to power	None (internal battery)
list connections to simulators	None
list connections to dummy loads	Water reservoir during checks
list unconnected terminals	External power/charger connector

distance from north wall (meters) 0.75
distance from south wall (meters) 0.75
distance form east wall (meters) 2.00
distance from west wall (meters) 2.00
distance from ceiling (meters) 2.16
distance from floor (meters) 0.09

Time of test start: 11:48

Performance checks during test:

First check:

Time: 12:18
Temperature: 0 degrees C
Humidity: 0 percent
Barometric pressure: 1 atm
Item functional (based on performance test criterion):
Yes 500 ml: 4.8 seconds
Deviation from pretest: None

Second check:

Time: 12:48
Temperature: 0 degrees C
Humidity: 0 percent
Barometric pressure: 1 atm
Item functional (based on performance test criterion):
Yes 500 ml: 4.8 seconds
Deviation from pretest: None

Third check:

Time: 13:18
Temperature: 0 degrees C
Humidity: 0 percent
Barometric pressure: 1 atm
Item functional (based on performance test criterion):
Yes 500 ml: 4.7 seconds
Deviation from pretest: None

POSTTEST DATA

Posttest performance check:
(complete check of item and accessories)
Time of test end: 14:10
Item functional (based on performance test criterion):
Yes 500 ml: 4.6 seconds
Deviation from pretest: None

Comments on item setup or checks: None

Comments on test run (including interruptions): None

Comments on other data: None

Test & Evaluation Number: 2

Low Temperature Test
(equipment in storage)
Report Form

Nomenclature: Suction pump
Manufacturer: Laerdal
Model number: LSU
Serial number: 034892
Military item number: A0137
Options installed: None

Test equipment used:

Tenney Engineering model ZWUL-10107D Walk-in Controlled Environment Chamber.

Date of test: 7 July 1988

Item configuration during test:

The door of the pump was closed and the pump was sitting horizontally on the floor of the chamber.

Performance test criterion:

The pump was to suction 500 ml of water in approximately 5 seconds.

Ambient conditions outside chamber:

Temperature	24 degrees C
Humidity	54 percent
Barometric pressure	1 atm

PRETEST DATA

Pretest performance check:
Item functional (based on performance test criterion): Yes 500 ml: 4.7 seconds

Installation of item in test facility:

list connections to power	None
list connections to simulators	None
list connections to dummy loads	None
list unconnected terminals	External power/charger connector
distance from north wall (meters)	0.75
distance from south wall (meters)	0.75
distance form east wall (meters)	2.0

distance from west wall (meters) 2.0
distance from ceiling (meters) 2.16
distance from floor (meters) 0.0

Time of test start: 8:45
Midtest time: N/A
Midtest temperature: N/A

POSTTEST DATA

Posttest performance check:
(complete check of item and accessories)
Time of test end: 15:50
Item functional (based on performance test criterion):
Yes 500 ml: 4.3 seconds
Deviation from pretest: None

Comments on item setup or checks: None

Comments on test run (including interruptions): None

Comments on other data:

The pump door was opened and the unit was left in the chamber overnight in order to allow condensed water to evaporate.

Test & Evaluation Number: 2

Humidity Test
Report Form

Nomenclature: Suction pump
Manufacturer: Laerdal
Model number: LSU
Serial number: 034892
Military item number: A0137
Options installed: None

Test equipment used:

Tenney Engineering model ZWUL-10107D Walk-in Controlled Environment Chamber.

Date of test: 8 July 1988

Item configuration during test:

The pump was ready to operate and was sitting vertically on the floor of the chamber.

Performance test criterion:

The pump was to suction 500 ml of water in approximately 5 seconds.

Ambient conditions outside chamber:

Temperature	25 degrees C
Humidity	58 percent
Barometric pressure	1 atm

PRETEST DATA

Pretest performance check:

Item functional (based on performance test criterion): Yes 500 ml: 4.3 seconds

Installation of item in test facility:

list connections to power	None (internal battery)
list connections to simulators	None
list connections to dummy loads	None
list unconnected terminals	External power/charger connector
distance from north wall (meters)	0.75

distance from south wall (meters) 0.75
distance form east wall (meters) 2.0
distance from west wall (meters) 2.0
distance from ceiling (meters) 2.16
distance from floor (meters) 0.0

IN-TEST DATA

Time of test start: 11:30

Performance checks during test:

First check:

Time: 12:15
Temperature: 29.5 degrees C
Humidity: 95 percent
Barometric pressure: 1 atm
Item functional (based on performance test criterion):
Yes 500 ml: 4.6 seconds
Deviation from pretest: None

Second check:

Time: 13:00
Temperature: 29.3 degrees C
Humidity: 94 percent
Barometric pressure: 1 atm
Item functional (based on performance test criterion):
Yes 500 ml: 4.6 seconds
Deviation from pretest: None

Third check:

Time: 13:45
Temperature: 29.5 degrees C
Humidity: 95 percent
Barometric pressure: 1 atm
Item functional (based on performance test criterion):
Yes 500 ml: 4.7 seconds
Deviation from pretest: None

Fourth check:

Time: 14:30
Temperature: 29.6 degrees C
Humidity: 94 percent
Barometric pressure: 1 atm
Item functional (based on performance test criterion):
Yes 500 ml: 4.7 seconds
Deviation from pretest: None

Fifth check:

Time: 15:15
Temperature: 29.5 degrees C
Humidity: 95 percent
Barometric pressure: 1 atm
Item functional (based on performance test criterion):
Yes 500 ml: 4.7 seconds
Deviation from pretest: None

POSTTEST DATA

Posttest performance check:
(complete check of item and accessories)
Time of test end: 15:30
Item functional (based on performance test criterion):
Yes 500 ml: 4.8 seconds
Deviation from pretest: None

Comments on item setup or checks: None

Comments on test run (including interruptions): None

Comments on other data: None

****

Electromagnetic characteristics testing
evaluation of performance
****

T & E item number: 2 Date: 11 July 1988

Nomenclature: Suction unit Manufacturer: Laerdal

Model number: LSU Serial number: 034892

Military item number: A0137

****

Conducted emissions tests

CE01 Testing configuration(s): N/A
Performance (pass/fail):
Comments:

CE02 Testing configuration(s): N/A
Performance (pass/fail):
Comments:

CE04 Testing configuration(s): N/A
Performance (pass/fail):
Comments:

Conducted susceptibility tests

CS02 Testing configuration(s): N/A
Performance (pass/fail):
Comments:

CS06 Testing configuration(s): N/A
Performance (pass/fail):
Comments:

Radiated emissions tests

RE02 Testing configuration(s): Battery operation, no load

Performance (pass/fail): Fail

Comments:
BB emissions 0.1 to 9.9 dB over specs, in frequency range 175 kHz to 969 MHz.

Radiated susceptibility tests

RS03 Testing configuration(s): Battery operation, no load

Performance (pass/fail): Pass

Comments:
Not susceptible to fields generated in test.

3.3 CRITERIA

Item No.	Criteria (Source)	Remarks	Applicable subparagraph
1	The LSU will suction 500 ml of water in approximately 5 seconds.	met	2.1.2.2
2	Verify manufacturer's specified full power battery life expectancy of 1 hour.	met	2.2.2
3	The LSU must be rated satisfactory in all major categories of the evaluation. These include: visual displays, controls, maintainability, conductors, fasteners, test points, test equipment, fuses and circuit breakers, labels and coding, and safety.	met	2.3.2
4	The LSU will suction 500 ml of water in approximately 5 seconds while exposed to an altitude equivalency of 15,000 feet above sea level.	met	2.4.2
5	While exposed to vibrational stresses, the LSU will remain operational and be able to suction 500 ml of water in approximately 5 seconds.	met	2.5.2
6	During the high temperature operation check, the LSU must suction 500 ml of water in approximately 5 seconds.	met	2.6.2.1
7	After the high temperature storage cycle, the LSU must be able to suction 500 ml of water in approximately 5 seconds.	met	2.6.2.2
8	During the low temperature operation check, the LSU must be able to suction 500 ml of water in approximately 5 seconds.	met	2.7.2.1

9	After the low temperature storage cycle, the LSU must be able to suction 500 ml of water in approximately 5 seconds.	met	2.7.2.2
10	While exposed to a high humidity environment, the LSU must suction 500 ml of water in approximately 5 seconds.	met	2.8.2
11	The LSU shall not produce emissions in excess of the limits set forth in paragraph 6.13, MIL-STD-461A notice 4.	not met	2.9.2.1
12	The LSU shall not malfunction when it is subjected to radiated fields as specified in paragraph 6.20, MIL-STD-461A notice 4.	met	2.9.2.2
13	The medical tester shall be able to operate the LSU without physical or functional restrictions aboard the aircraft.	met	2.10.2.1
14	The LSU shall not radiate EMI to disrupt or interfere with the other equipment or systems aboard the aircraft.	met	2.10.2.2
15	The aircraft shall not radiate EMI to disrupt or interfere with the LSU.	met	2.10.2.3

3.4 REFERENCES

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3.4.5 Department of Defense. 1985. MIL-STD-454K. Standard general requirements for electronic equipment. Washington D.C. February.

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3.4.7 Department of Defense. 1989. MIL-STD-1472D. Human engineering design criteria for military systems, equipment, and facilities. Washington D.C. March.

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3.4.9 Department of the Army. 1978. TM 55-1520-237-10. Operator's manual, UH-60 and EH-60 helicopter, with changes 1-5. Washington D.C. January.

3.4.10 Laerdal Medical Corporation. 1979. Directions for use, Laerdal suction unit. Norway.

3.5 ABBREVIATIONS

AVSCOM	Army Aviation Systems Command
AEST	aeromedical equipment suitability test
AGL	above ground level
AWR	airworthiness release
CAAF	Cairns Army Airfield
DAETTEP	Director, Aeromedical Equipment Technical Test and Evaluation Program
DC	direct current
EMC	electromagnetic compatibility
EMI	electromagnetic interference
fpm	feet per minute
GFE	government furnished equipment
Gpk	gravity, peak
G(rms)	gravity (root mean square)
Hz	hertz
IAW	in accordance with
ITOP	in-flight test operating procedure
KHz	kilohertz
KIAS	knots indicated airspeed
LSU	Laerdal Suction Unit
MEDEVAC	medical evacuation
MHz	mega hertz
MIL-STD	military standard
ml	milliliter
mmHg	millimeters of Mercury
MSL	mean sea level
NBC	nuclear, chemical, and biological
NVG	night vision goggle
RFI	radio frequency interference
TFT	technical feasibility testing
T & E	test and evaluation
UES	Universal Energy Systems, Inc.
USAARL	U.S. Army Aeromedical Research Laboratory
VAC	volts alternating current
V/m	volts per meter

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